Initial serum lactate levels of COVID-19 patients

Lactate in COVID-19

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Abstract

Aim: In this study, we aimed to research whether the serum lactate of the COVID-19 patients presented to the initial emergency department can be used to make prognosis of the patients.

Materials and Methods: A total of 39 COVID-19 patients were included in the study. Fourteen (35.8%) patients were over 65 years old (Group 1). Twenty-five patients (64.2%) were under 65 years old (Group 2). The diagnosis was made via the oro-nasopharyngeal swab PCR test. We noted the demographic data (age, gender, comorbidities), initial (emergency service presentation) complete blood count parameters including WBC, Plt/Lymp ratio, CRP, procalcitonin and serum lactate levels. We also noted the hospitalization unit (clinic/intensive care unit), hospitalization length, and the outcomes. Patients were divided into two groups according to 65 years and the groups' laboratory results with the prognosis.

Results: The mean age of the study group was 55 years. Fourteen (35.8%) patients were over 65 years old. Serum lactate levels did not significantly differ between groups. Hospital length of stay was significantly longer in patients over 65 years of age. Age and hospitalization length were positively correlated with age in all patients.

Discussion: Serum lactate level measurement has recently become an important parameter especially for critically ill patients. It is beneficial for predicting the severity and prognosis in severe infections. Serum lactate levels in COVID-19 patients did not differ between age groups. Hospitalization length was longer in elderly patients.

Keywords
COVID-19; Lactate; Prognosis

Introduction

COVID-19 is a worldwide pandemic viral infection with a high prevalence and mortality rate [1]. Up to date, millions of people have been infected all over the world [2]. This rapid-spreading infection causes several systemic effects, such as pneumonia and myocarditis, on the other hand, most of the infected people may not have any symptom or a clinical finding [3,4]. The main symptoms and clinical findings include fever, cough, fatigue, loss of smell and taste dysfunction, and typical CT images of ground-glass [5,6].

Serum lactate is a well known valuable prognostic marker for different clinical situations, such as serious infections and sepsis [7-9]. Serum lactate level has a positive correlation with mortality in critically ill patients with severe infection [8-10]. Emergency clinicians use lactate for providing early goals of sepsis when the level is higher than 4.0 mmol/L [11,12]. It is an easy accessible, cheap and can be achieved from venous blood gase immediately.

The COVID-19 patients first present to the COVID area which is settled as a part of our emergency department. Emergency clinicians follow-up these patients till hospitalization in the inpatient clinic or intensive care unit. Because of a lack of data from the emergency departments, in this study, we aimed to research whether the serum lactate of the COVID-19 patients at the initial presentation to the emergency department can be used to make the prognosis of the patients. We also aimed to determine whether there is a difference between the patients under 65 years old and over 65 years old.

Material and Methods

After the ethics committee approval, in this retrospective study, we evaluated COVID-19 diagnosed and hospitalized patients between 15 March 2020 and 31 March 2020. Totally 39 COVID-19 patients were included. Fourteen (35.8%) patients were aged over 65 years (Group 1). Twenty-five patients (64.2%) were under 65 years old (Group 2). The diagnosis is made via the oro-nasopharyngeal swab PCR test. We noted the demographic data (age, gender, comorbidities), initial (emergency service presentation) complete blood count parameters including WBC, plt/lymp ratio, CRP, procalcitonin, and serum lactate levels. We also noted the hospitalization unit (clinic/intensive care unit), hospitalization length, and the outcome. Patients were divided into two groups according to 65 years and the groups' laboratory results with the prognosis.

We included all COVID-19 diagnosed and hospitalized patients in this study. The exclusion criteria were patients under 18 years old, cardiopulmonary arrest in the ED, and the pregnants.

Statistical Analyses

Statistical comparisons were performed using the statistical software package SPSS 23.0 (SPSS Inc., Chicago, IL, USA). The Shapiro-Wilks test was used for normal distribution. For comparing parameters without normal distribution, the Mann-Whitney U test was used. The Chi-Square test was used for comparing the categorical variables. The Spearman's test was used for correlation analyses. Definitive statistics were noted as "Mean ± standard deviation (SD)" and " Median (interquartiles, IQR)". The significance level was 0.05.

Results

We included 21 males, 18 females, totally 39 patients in our study. The mean age of the study group was 55 years. Fourteen (35.8%) patients were aged over 65 years. Serum lactate levels were not significantly different between groups. Hospitalization length was significantly longer in the patients aged over 65 years. The hospitalization unit and the outcomes did not differ between the groups (Table 1). Age and hospitalization length were positively correlated with age in all patients (Table 2).

Table 1. Clinical characteristics and differences between groups according to 65 years of age

	All patients n=39	>65 years n=14	<65 years n=25	P
Age	55 (36-68)	76 (66-80)	38 (28-55)	0.000
Males	21 (53.8%)	4 (28.6%)	17 (68.0%)	0.018
DM	9 (23.1%)	5 (20.0%)	4 (28.6%)	0.696
HT	6 (15.4%)	1 (4.0%)	5 (35.7%)	0.016
WBC	6900 (4900-9600)	7400 (4600-9450)	6300 (5000-9800)	0.740
CRP	18.2 (6.7-76.2)	28.9 (11.2-100.8)	13.6 (4.6-73.1)	0.263
PCT	0.05 (0.02-0.12)	0.09 (0.04-0.97)	0.03 (0.02-0.1)	0.051
Lactate	14 (11-17)	14 (8-15)	15 (12-18)	0.098
Hospital Length	6 (4-11)	10 (5-18)	5 (4-7)	0.012
Hospital into ICU	5 (12.8%)	2 (8.0%)	3 (21.4%)	0.329
Ex ratio	4 (10.3%)	1 (4.0%)	3 (21.4%)	0.123

DM: Diabetes mellitus, HT: Hypertension, WBC: White blood cell, CRP: C-Reactive Protein, PCT: Procalcitonin, ICU: Intensive Care Unit

Table 2. Correlation analyses in all COVID-19 patients

	Age	Lactate (mg/dl)	WBC	PCT	CRP	Hospital. Length	Hospital. Unit
Age		r=-0.210 p=0.198	r=0.225 p=0.168	r=0.414 p=0.09	r=0.327 p=0.042	r=0.44 p=0.04	r=0.368 p=0.02
Lactate (mg/dl)	r=-0.210 p=0.198		r=0.107 p=0.516	r=0.004 p=0.979	r=0.062 p=0.707	r=-0.019 p=0.907	r=-0.151 p=0.36
WBC	r=0.225 p=0.168	r=0.107 p=0.516		r=0.004 p=0.979	r=0.296 p=0.067	r=0.102 p=0.537	r=0.266 p=0.102
PCT	r=0.414 p=0.09	r=0.004 p=0.979	r=0.004 p=0.979		r=0.601 p=0.000	r=0.142 p=0.389	r=0.175 p=0.287
CRP	r=0.327 p=0.042	r=0.062 p=0.707	r=0.296 p=0.067	r=0.601 p=0.000		r=0.301 p=0.062	r=0.279 p=0.085
Hospital. Length	r=0.44 p=0.04	r=-0.019 p=0.907	r=0.102 p=0.537	r=0.142 p=0.389	r=0.301 p=0.062		r=0.093 p=0.657
Hospital. Unit	r=0.368 p=0.02	r=-0.151 p=0.36	r=0.266 p=0.102	r=0.175 p=0.287	r=0.279 p=0.085	r=0.093 p=0.657	

Discussion

In this study, we included 39 COVID-19 PCR test positive patients. Hospitalization length was significantly longer in the patients aged over 65 years. Serum lactate levels, hospitalization unit, and the outcome did not differ between groups. Age and hospitalization length were positively correlated with age in all patients

Serum lactate level measurement is one of the most important tools for emergency clinicians. The physiologic processes of this marker are well defined and overproduction of this molecule and decreased elimination provide important data for critically ill patients, such as sepsis or other serious infections [13,14]. Anaerobic metabolism of the tissues results in high production

of lactate and it is known that hyperlactatemia occurs in serious infections [15], and hyperlactatemia is associated with a higher mortality ratio in these patients [16]. As a result, when the initial serum lactate is high, additional clinical interventions should be provided to decrease tissue hypoxia. Oxygen support has not been shown clinically [17,18]. Cryptic shock is a term to define the normotensive septic patients with elevated serum lactate and it is related to high mortality. A high death ratio occurs when the serum lactate level is 4 mmol/L or higher [11]. This year, the COVID-19 pandemic has affected the whole world, and we do not have enough knowledge to manage these patients. Data on critically ill COVID-19 patients are especially important for all clinicians to save the lives of victims. The emergency management data on serum lactate levels are limited for these critically ill patients. According to a COVID-19 case series, hypotension occurred in 17 of 24 patients, which required fluid and vasopressor administration. Similarly, serum lactate levels are higher in critically ill COVID patients [13,18]. These data suggested us the lactate level can be a prognostic factor as it is commonly used in sepsis and septic shock.

Limitations
We included a small study group in this study because of the limited conditions and the required immediate data.

Conclusion
COVID-19 patients' serum lactate levels did not differ between age groups. Hospitalization length was longer in elderly patients. Further comprehensive studies are required for the prediction of lactate levels, especially in critically ill COVID-19 patients, and also, serial lactate measurement might be more effective in the management.

References
1. Zhang X. Epidemiology of COVID-19. N Engl J Med. 2020;382(19):1896. DOI:10.1056/NEJMc2005157.
2. Huang X, Wei F, Hu L, Wen L, Chen K. Epidemiology and Clinical Characteristics of COVID-19. Arch Iran Med. 2020;23(4):268-71. DOI:10.34172/aim.2020.09.
3. Shi H, Han X, Jiang N. Radiological findings from 81 patients with COVID-19 pneumonia in Wuhan, China: a descriptive study. Lancet Infect Dis. 2020;20(4):425-34. DOI: 10.1016/S1473-3099(20)30086-4.
4. Inciardi RM, Lupi L, Zaccone G, Italia L, Raffo M, Tomasoni D, et al. Cardiac Involvement in a Patient With Coronavirus Disease 2019 (COVID-19). JAMA Cardiol. 2020; DOI: 10.1001/jamacardio.2020.1096.
5. Hu Z, Song C, Xu C. Clinical characteristics of 24 asymptomatic infections with COVID-19 screened among close contacts in Nanjing, China. Sci China Life Sci. 2020;63(5):706-11. DOI: 10.1007/s11427-020-1661-4.
6. Xydakis MS, Dehgani-Mobaraki P, Holbrook EH. Smell and taste dysfunction in patients with COVID-19. Lancet Infect Dis. 2020;: DOI: 10.1016/S1473-3099(20)30293-0.
7. Puskarich MA, Jaillette E, Girault C, Brunin G, Zerimech F. Prognosis of emergency department patients with suspected infection and intermediate lactate levels: a systematic review. J Crit Care. 2016;20(Suppl.2):S94. DOI: 10.1186/s13054-016-1208-6.
8. Bakker J, Gris P, Coffernils M, Kahn RJ, Vincent J-L. Serial blood lactate levels can predict the development of multiple organ failure following septic shock. Am J Surg. 1996;171(2):221–6.
9. Jansen TC, van Bommel J, Bakker J. Blood lactate monitoring in critically ill patients: a systematic health technology assessment. Crit Care Med. 2009;37(10): 2827–39.
10. Mikkelsen M, Miltiades A, Gaieski D. Serum lactate is associated with mortality in severe sepsis independent of organ failure and shock. Crit Care Med. 2009;37:1670–7.
11. Rivers E, Nguyen B, Havstad S. Early goal- directed therapy in the treatment of severe sepsis and septic shock. N Engl J Med. 2001;345(19):1368–677.
12. Wardi G, Brice J, Correia M, Liu D, Self M, Tainter C. Demystifying Lactate in the Emergency Department. Ann Emerg Med. 2020;75(2):287-98. DOI: 10.1016/j.annemergmed.2019.06.027.
13. Li X, Wang L, Yan S. Clinical Characteristics of 25 Death Cases With COVID-19: A Retrospective Review of Medical Records in a Single Medical Center, Wuhan, China. Int J Infect Dis. 2020; DOI: 10.1016/j.ijid.2020.03.053.
14. Wacharasint P, Nakada TA, Boyd JH, Russell JA, Walley KR. Normal-range blood lactate concentration in septic shock is prognostic and predictive. Shock. 2012;38(1):4-10.
15. Puskarich MA, Trzeciak S, Shapiro NI, Heffner AC, Kline JA, Jones AE. Outcomes of patients undergoing early sepsis resuscitation for cryptic shock compared with overt shock. Resuscitation. 2011;82(10):1289-93.
16. Hayes MA, Timmins AC, Yau EH, Palazzo M, Hinds CJ, Watson D. Elevation of systemic oxygen delivery in the treatment of critically ill patients. N Engl J Med. 1994;330(24):1717-22.
17. Marik PE, Sibbald WJ. Effect of stored-blood transfusion on oxygen delivery in patients with sepsis. JAMA. 1993;269(23):3024-9.
18. Bhatraju PK, Ghassemieh BJ, Nichols. COVID-19 in Critically Ill Patients in the Seattle Region - Case Series. Engl J Med. 2020;DOI: 10.1056/NEJMoa2004500.